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RF-46469 (Rev. 9'92)

April 7, 1993 93-RF-4310

Halliburton NUS Environmental Corp.
452 Burbank Street
Broomfield, CO 80020

Attn: John Schmidt

Radiological Risk Assessment - SRK-108-93

Ref.: Subcontract PC 84017JB Rocky Flats Solar Pond/Pondcrete Project
HNUS letter 12/07/92, RF-HED-92-0842

Per your request in referenced letter, attached for your use is the "Radiological Risk Assessment Solar Pond 207-C and Clarifier Waste Stream General Site Access," as performed by Keith D Anderson, Radiological Engineering, EG&G Rocky Flats, Inc., as provided to us via letter KDA-027-92, 9/29/92, K. D. Anderson to E. M. Lee (attached).

If you have any questions, please call me at 966-8541.

S. R. Keith
Pondsludge Project Manager
Solar Ponds Remediation Program
EG&G Rocky Flats, Inc.

jec

Attachment:
As stated

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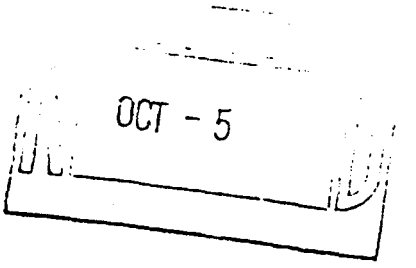

DATE: September 29, 1992

TO: E. M. Lee, Environmental Restoration, Bldg. 080, X8523

FROM: K. D. Anderson, Radiological Engineering, Bldg. T690B, X5151

SUBJECT: RADIOLOGICAL RISK ASSESSMENT FOR SOLAR POND PROJECT - KDA-027-92

In response to a request submitted by Halliburton-NUS Environmental Corporation, the following risk assessment is submitted for the Solar Pond Area and Solar Pond 207-C and Clarifier Process Train. The focus of the assessment is the hazard associated with the inhalation of identified radiological contaminants. Conclusions and recommendations are included.

Based upon the indicators provided by the risk assessment, Radiological Engineering will require Modified Level D as a minimum for the Process and Level C for spill response or breech of containment.

The information included in this risk assessment should be provided to Halliburton-NUS Environmental Corporation.

Please contact R. W. Norton, Extension 4075, Digital Page 0971 or myself, Extension 5151, Digital Page 3296, for further assistance in this matter.

kda

cc:
G. M. Aldrich
L. A. Collins, w/o Attachment
D. R. Ferrier
R. W. Norton
T. L. Vaughn, w/o Attachment

J. B. Mellen ____
R. E. James X
S. R. Keith X
D. R. Cowen ____
D. R. Ferrier X
D. R. Ringle ____
K. C. London ____
S. P. Thrasher X
Other:

Action:
Due:
Transmit to HNUS

Notes:

Radiological Risk Assessment
Solar Pond 207-C and Clarifier Waste Stream
General Site Access
Submitted by Keith. D. Anderson
Radiological Engineering

I. Objective

The Object of the report is to evaluate the potential radiological hazards from the inhalation of radionuclides to workers assigned to the Solar Ponds Consolidation Project. It is stressed that the assessment covers general access personnel to the Solar Pond Area and hands on workers as determined by the Site Specific Health and Safety Plan.

II. Hazard Characterization

Characterization of the potential radiological hazard involves the comparison of the workers relative exposure to established standards as applicable. For the purpose of this report, internal deposition through inhalation is considered the worst case scenario.

The principle components inclusive to the evaluation are the 1) radiological contamination source and 2) exposure from the contamination source. An evaluation will be conducted for the 207-C and Clarifier media and the general access to the Solar Pond Area.

A. Radiological Contamination Source

Activity concentration for this evaluation are taken from the Site Specific Health and Safety Plan for the Solar Pond Project and the Pond Sludge Waste Characterization Report and Clarifier Sludge Waste Characterization Report. (Table 1 and 2). Table 1 lists the maximum detected activities from sample analysis of the Solar Pond 207-C media, Table 2 the Clarifier media. By utilizing maximum concentration as a relative indicator of the contamination source, a conservative nature is applied to the quality of the evaluation. This secures the safety envelope, although tending to over estimate the potential of the hazard. In addition, the maximum contamination activity is utilized in all exposure computations to ensure all necessary precautions are taken to protect personnel at this location.

It has been identified that the primary radiological hazard of the Solar Pond 207-C and Clarifier media will be internal exposures, with the most probable route being inhalation. Internal exposure via inhalation has been identified as the primary radiological hazard associated with the Solar Pond 207-C and Clarifier media[1]. Therefore, the nature of the evaluation will focus on

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[1]Deliverable 750C, Health and Safety Plan, Solar Ponds Waste Processing Areas for EG&G Rocky Flats. Prepared by Halliburton NUS Environmental Corporation, Revision 2, June 11, 1992.

predicting the resuspension of the media. Two methods have been identified for estimations of airborne radioactivity concentrations; 1) using resuspension factors that provide indicators of the probable airborne concentration or 2) relating specific dust loading values to the media airborne radioactivity concentrations. This evaluation will use the resuspension methodology.

Table 1. Radioactivity Concentration of Solar Pond 207-C

Isotope	Media	Activity (pCi/l)
Gross Alpha	Water	130000
Gross Beta/Gamma	Water	230000
Plutonium 239	Water	670
Uranium 234	Water	2600
Uranium 235	Water	120
Uranium 238	Water	3900
Gross Alpha	Composite Sludge	8700
Gross Beta/Gamma	Composite Sludge	1200
Plutonium 239	Composite Sludge	15
Uranium 234	Composite Sludge	5.2
Uranium 235	Composite Sludge	0.84
Uranium 238	Composite Sludge	31

Table 2. Radiological Activity Concentration of Clarifier

Isotope	Media	Activity Concentration (pCi/L)
Gross Alpha	Water	19000
Gross Beta/Gamma	Water	30000
Gross Alpha	Composite Sludge	6600
Gross Beta/Gamma	Composite Sludge	860

In addition, soils in the vicinity of the Solar Ponds are known to be radiologically contaminated. This presents a potential hazard to personnel who access the area. Mean ^{241}Am activity as measured with a High Purity Germanium Detector and laboratory analysis for ^{239}Pu in soil are shown in Table 3. The soil contamination levels listed clearly shows that there are levels that exceed background. This suggests an exposure scenario to Workers at the site. The report deals with this concern by equating the potential for exposure to general access workers to data collected from the realtime low volume air monitoring from

the Radioactive Ambient Air Monitoring Program (RAAMP) samplers located at the Solar Ponds. This information is utilized to determine the realtime exposure to Workers.

Specific risk assessment of resuspension of soil contaminants is not conducted for this evaluation. It is not anticipated that significant intrusive activities of surface soils will occur as part of the Project. If, in the future, soil disturbance does occur, an additional risk assessment will be conducted based upon the "Final, Plan for the Prevention of Contamination Dispersion".

B. Exposure from Contamination Source

1. Resuspension Methodology

Indirect measurement of the radioactivity airborne concentration can be accomplished by calculating the resuspension of material. This in turn can be used to determine the exposure environment of personnel who are working within an area. The technique may introduce significant errors based upon the reliability of the factor incorporated in the calculation. An example would be the resuspension factor chosen, which is itself a statistically derived value. The more assumptions made, the greater the compounding error. Using values listed in Tables 1 and 2, the potential Worker exposures from handling noncontained media from Solar Pond 207-C and the Clarifier has been determined (Calculation 1). Representative radioactive airborne concentration values are compared to specific Derived Air Concentration (DAC) limits listed in Department of Energy Order 5480.11, Radiation Protection for Occupational Workers. The DACs, if inhaled by a Worker for 8 hours/day over 250 working days in a year, would produce an intake equal to the Annual Limit of Intake (ALI) (EPA-520/1-88-020). DOE Order 5480.11 specifies that respiratory protection is required for Workers exposed to 10% DAC or greater.

From the calculation, it is determined that the potential for the radioactive airborne contamination to exceed 10% DAC does exist for the waste streams identified.

Calculation 1. Worker Exposure from Solar Pond 207-C Waste Stream

Spill size: The spill is based upon operational activities and potential container volume. The RCRA reportable pint or pound was not used, however, it is just as viable a quantity.

1 halfcrate = 1.75 yd^3 * [(0.7646 m^3/ yd^3] = 2.28 m^3

Source material: Solar Pond 207-C, consolidated water and sludge.

Calc. 1, cont.

Radioactive Source Concentration: 130000 pCi/l, gross alpha, maximum value, assume 1ml = 1 cm^3:

= (130000 pCi/l)(1 l/10^3 ml)(1ml/cm^3)[(10 cm)^3/(1 m)^3)(2.28 m^3 material)

= 173940 pCi/m^3

Using a resuspension factor of 10^{-4} (REF), the potential for the contamination source to become airborne can be determined[2].

173940 pCi/m^3 x 10^{-4} = 17.394 pCi/m^3.

Release in typical puff form, total volume 1 m^3, conservative dispersion for airborne concentration.

17.394 pCi/m^3 * (1 m^3/1000 l) = 0.017394 pCi/l.

DAC for ^{239}Pu = 2 x 10^{-12} pCi/ml = 0.002 pCi/l

DAC = (Measured Concentration / DAC)

DAC = (0.017394 pCi/l)/(0.002 pCi/l) = 8.7 DAC

Performing the same calculation using the isotopic specific measurement for ^{239}Pu of 670 pCi/l for Solar Pond 207-C, using the same assumptions as presented for the gross alpha activity concentration, the following DAC is arrived at:

DAC = (8.96 x 10^{-5} pCi/l)/(0.002 pCi/l) = 0.045 DAC

Repeating the calculation substituting the values for the total Uranium constituents present in Solar Pond 207-C water and composite sludge respectively (Table 1), the following DACs are arrived at:

Water:

DAC for ^{234,235,238}U = 2 x 10^{-11} pCi/ml = 0.02 pCi/l

Concentration of ^{234,235,238}U = 6620 pCi/l

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[2]NUREG-1400, Air Sampling in the Workplace, Draft Report for Comment, U. S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, E. E. Hickey et. al. The Release Fraction selected is for liquids, 0.0001. It is assumed that the material from the spill will be in a liquid form.

Calc. 1, cont.

DAC = (0.000886 pCi/l)/(0.02 pCi/l) = 0.044 DAC.

Composite Sludge:

Concentration of $^{234,235,238}U$ = 37 pC/l

DAC = $(4.95 \times 10^{-6})/(0.02$ pCi/l) = 2.47×10^{-4} DAC.

Utilizing the same assumptions for Solar Pond 207-C, substituting the gross alpha (^{239}Pu) and the gross beta/gamma ($^{234, 235, 238}U$) measured activity concentrations for the Clarifier (Table 2), the potential DACs may be determined (Calculation 2)

Calculation 2, Worker Exposure from Clarifier Waste Stream

Clarifier water, detected activity concentration, 19000 pCi/l gross alpha:

DAC = $(2.53 \times 10^{-3})/(0.002$ pCi/l) = 1.26 DAC.

Clarifier composite sludge, detected activity concentration, 6600 pCi/l gross alpha:

DAC = $(8.83 \times 10^{-4})/(0.002$ pCi/l) = 0.44 DAC.

Clarifier water, detected activity concentration, 30000 pCi/l gross beta/gamma:

DAC = $(3.99 \times 10^{-3}$ pCi/l)/(0.02 pCi/l) = 0.19 DAC.

Clarifier composite sludge, detected activity concentration, 860 pCi/l gross beta/gamma:

DAC = $(1.15 \times 10^{-4})/(0.02$ pCi/l) = 5.75×10^{-3} DAC.

The expected radiological exposure for Non-Intrusive work activities and Visitors to the Solar Pond area can be determined utilizing results from the Radioactive Ambient Air Monitoring Program (RAAMP) associated with the site. The RAAMP monitors the environmental concentrations of airborne radionuclides. Measure ambient ^{239}Pu air concentrations are presented for 1990 (Table 3) Utilizing this information, a determination of the Occupational Exposure for non-intrusive work and Visitors to the Solar Pond area can be determined (Calculation 3). A potential DAC of 1.46×10^{-3}, equating to a dose equivalent of 3.65×10^{-3} mrem was calculated.

Table 3. Measured Ambient Plutonium-239 Air Concentration in the vicinity of the Solar Evaporation Ponds.

Period (1990)	^{239}Pu pCi/m^3 (ND = No Data)
January	ND
February	0.000336
March	0.000516
April	0.001596
May	0.001983
June	0.003057
July	0.000813
August	ND
September	0,000436
October	0.000902
November	0.000589
December	ND
Mean	0.001136
Standard Deviation	0.000908

Calculation 3. Non-Intrusive Exposures.

Mean measured ambient ^{239}Pu in the vicinity of the Solar Evaporation Ponds:

$\bar{X} = 0.001136 \pm 1.96(0.000908)$ pCi/m^3

$\bar{X} = 0.001136 \pm 0.00178$ pCi/m^3

$\bar{X} = 0.00292$ pCi/m^3

$\bar{X} = 0.00292$ pCi/m^3)(m^3/1000l) = 2.92×10^{-6} pCi/l.

The measured DAC:

DAC = (2.92×10^{-6} pCi/l)/(0.002 pCi/l) = 1.46×10^{-3} DAC.

III. Conclusion and Recommendation

Based upon the results of the risk assessment, an indicated potential exists to exceed the exposure the limitation of 0.10 DAC following loss of containment of

material. This would be the case regardless of the identified waste stream, i.e. Solar Pond 207-C or the Clarifier. However, no exposure exceeding 0.10 DAC would be expected from general access to the Solar Pond Area.

The appropriate mitigation of the potential hazard would be the utilization of engineering controls. Such controls have been built into the system, such as primary and secondary containment, ventilation control, and High Efficiency Particulate Air (HEPA) ventilation filtration system. The process is designed to provide containment throughout the mixing and casting of the waste stream, further reducing the potential hazard. Given this, the level of personal protective equipment (PPE) could be downgraded.

For normal process operations, it is anticipated that modified Level D, as per the Site Specific Health and Safety Plan (SSHSP), will be required. In the event of loss of containment, an upgrade of PPE to Level C will follow. The protection factor associated with the HEPA filtered full face respirator will be sufficient to insure that personnel responding to a spill or breaching containment will not receive exposures in excess of acceptable levels.